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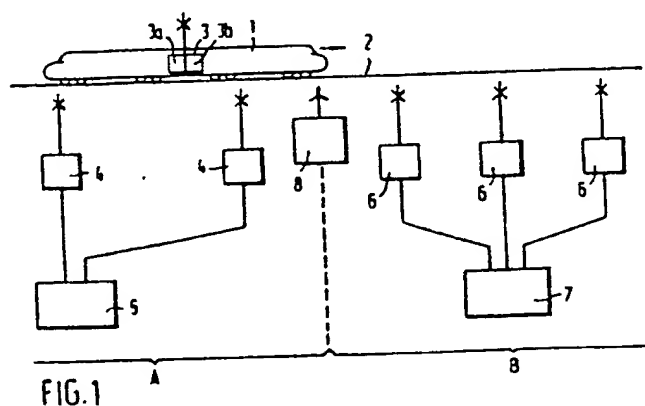
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(54) Radio communication system provided with beacon transmitters.

(57) Radio communication system for speech or data communications between a mobile transceiver (3) disposed in a means of transport (1) and fixed transceivers (4) located along the road (2) on which the means of transport moves and connected to the control centres (5, 7) belonging to the several road sections (A, B). A beacon transmitter (8) transmitting a signal with parameters in an encoded form is disposed at a point where the one road section ends and the next one begins. The parameters can relate to channel frequencies and addressing and identification codes applicable to the road section entered by the means of transport. In the mobile transceiver the beacon transmitter signal is encoded and the mobile transceiver set in conformity with the received parameters. For the sake of the possibility that the means of transport can pass along the beacon transmitter in two opposite directions, the parameters of both the one and the other road section at the border of which the beacon transmitter is located, are transmitted. When passing along the beacon transmitter, the mobile transceiver compares all the received parameters with those to which it is set at that moment and after that it changes its setting in conformity with the parameters deviating from the actual setting. In addition to the setting parameters the beacon transmitter can also transmit complementary system data, such as a beacon transmitter identification code and a beacon transmitter condition parameter, which complementary system data can be transmitted to the fixed transceivers and to the associated control centre via the mobile transceiver.



Radio communication system provided with beacon transmitters.

A. Background of the invention

1. Field of the invention

The invention relates to a radio communication system for establishing and maintaining radio speech or data communications between on the one hand a mobile transceiver disposed in a means of transport which follows an, at least partly, predetermined road, and on the other hand fixed transceivers located along road sections forming the predetermined road, which fixed transceivers are in communication with a control centre belonging to a road section, which mobile transceiver comprises receiving means and processing means for receiving respectively processing system signals, a fixed beacon transmitter being disposed near a point where a first road section ends and a next one begins, which beacon transmitter transmits a system control signal, and the processing means setting the mobile transceiver on reception of the system control signal received via the receiving means during the time when the beacon transmitter was passed along.

2. State of the art

A system corresponding to the field of the invention is known from the German Offenlegungsschrift 2644206. This system utilizes radio-beam links with channel frequencies > 1 GHz to avoid unwanted interference of the signals transmitted by the fixed transmitters. Use is made of two pairs of different transmission-

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receive channels, which are exchanged at each road section. The mobile transceiver is switched over either by means of an automatic selection by the mobile receiver of the receive channel with the greatest receiving strength, or by means of a separate transmitter disposed near the point where one road section ends and a next one begins, which transmitter delivers a control signal to the mobile transceiver. Because of the fact that only two pairs of channel frequencies are utilized said control signal is not encoded, but on reception of the control signal the transceiver will be switched over from one pair of frequencies to another pair of frequencies.

A drawback of the known system is that it is a radio-beam link system, which works only at very high channel frequencies. This involves that it will be necessary to work with relay or intermediate stations disposed at a distance of 0.5 to 1 kilometre from one another. Another drawback is that two different pairs of transmission-receive channels at most can be used.

B. Summary of the invention

The present invention provides a radio communication system of the sort defined under A1, which does not require the use of radio-beam links with very high channel frequencies and with relay or intermediate stations disposed with relatively short distances between them, but nevertheless no unwanted interferences will occur notably due to the great freedom of choice as to transmission and receive channels.

Characteristic of the invention is that the system control signal transmitted by the beacon transmitter comprises parameters, in an encoded form, for the sake of the establishment and maintenance of communications between the mobile transceiver and the fixed transceivers and their associated control centre within the next road section and that said processing means set the mobile transceivers in conformity with the received parameters on

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reception of the system control signal. The parameters can relate to the transmission and receive channel frequencies which are used in the next road section when messages are exchanged between the mobile transceiver and the fixed transceivers. Besides the
5 parameters can relate to addressing and/or identification codes to be used when messages are exchanged, for example an address code for the relevant control centre or for a certain part of that control centre.

To achieve that the system according to the invention works in
10 both directions of movement of the means of transport the beacon transmitter in a preferred embodiment of this invention transmits a system control signal comprising the parameters applying to the road section on the one side of the beacon transmitter as well as those applying to the road section on the other side of the
15 beacon transmitter. On reception of the beacon transmitter signal the received parameters are then compared in the mobile receiver with the parameters to which the mobile receiver is set at that moment, after which the mobile transceiver is set in conformity with the parameters deviating from the parameters actually set.
20 In this way the invention provides an extremely flexible system adaptable to the local circumstances of each road section, for example regarding the allotment of a frequency, and easy to change.

The system control signal transmitted by the beacon transmit-
25 ter can form part of a system signal, which comprises not only the parameters for setting the mobile transceiver but also supplementary system data in an encoded form. For example the system signal can comprise an identification code of the relevant beacon transmitter. This identification code can then be transmitted,
30 for example together with an identification code of the mobile transceiver, by the latter to the fixed transceivers, which transmit these codes to the control centre, where it is determined, by the reception of them, which means of transport

has passed along which beacon transmitter. Thus in this way an automatic regular determination of the position of means of transport will be possible.

5 As complementary system data the system signal transmitted by the beacon transmitter can further comprise condition parameters of the beacon transmitter itself, id est parameters which give an indication concerning its functioning. These parameters too are received by the mobile transceiver and transmitted to the control centre by means of retransmission to the fixed transceivers. This
10 can take place conditionally, notably only if the parameters give an indication that the beacon transmitter does not function sufficiently, or unconditionally. In this way it is achieved that the control centre (id est the control centre of the next road section) will be automatically alarmed, as soon as the beacon
15 transmitter (which works "stand alone") insufficiently functions.

According to a further elaboration of the invention a beacon transmitter consists of two transmitters, which transmit at the same time, the one transmitter transmitting a signal comprising
20 the condition parameters of the other one, and vice versa. It is also possible that the transmitters transmit by turns, in which case the signal strength itself functions as a condition parameter. As soon as the processing means of the mobile transceiver detect that one of the two beacon transmitter signals is too
25 weak, this will be automatically passed on to the control centre (via the fixed transceivers). The fixed transceivers within a certain road section will generally make use of different transmission channels in order to avoid interference between them. When the beacon transmitter at the beginning of the road section
30 is passed along, the channel frequencies will be derived from the system control signal transmitted by the beacon transmitter, as explained before, and the mobile transceiver will be set accordingly by the processing means. According to a technique

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which is known per se, the mobile transceiver can be provided with means for continuously scanning the relevant set channels and for selecting and switching through the channel with the greatest signal strength. After this channel has been selected and switched through the scanning process will be continued. If at a certain moment a greater signal strength is detected via another channel, the mobile transceiver (id est its receiving part) will be switched over to that channel. According to an embodiment of the invention said scanning and selecting means can scan not only the transmission channels of the fixed transceivers, but also the channel (respectively the channels) on which the beacon transmitters transmit and, switch over the receiving part of the mobile transceiver to this channel as soon as the greatest signal strength is detected on it. It will be understandable that this will be the case when the beacon transmitter is passed along.

C. Reference

DE-OS 2644206 in the name of Siemens A.G. published April 6, 1978.

D. Short description of the figures

Figure 1 shows the circuit diagram of a preferred embodiment of the present invention.

Figures 2 and 3 show block diagrams of the mobile transceiver and the beacon transmitter.

E. Description of the embodiment and figures

Figure 1 shows a diagrammatic representation of a train 1, running on a railway 2. The train is provided with a mobile transceiver 3, which comprises a communication transceiver 3a, via which a communication can be established with a number of fixed transceivers 4 located along the railway, and a beacon receiver 3b, capable of receiving signals transmitted by the

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beacon transmitters 8. The fixed transceivers 4 are connected via line communications to a control centre 5 of the train control area A. The beacon transmitters 8 work "stand alone" and transmit continuously. Adjacent to the control area A lies a train control area B, in which a control centre 7 is located, which is connected by line communications to a number of fixed transceivers 6. The channel frequencies of these transceivers 6 are different from those of the fixed transceivers 4. The addressing code for the control centre 5 differs from the addressing code for the control centre 7. When the train 1 crosses the line between the control area A and the control area B, it will pass along the beacon transmitter 8, which constantly transmits a code signal which comprises the channel frequency (or frequencies) of the fixed transceivers 4, the addressing code of the control centre 5, the channel frequency (or frequencies) of the fixed transceivers 6 and the addressing code of the control centre 7. Moreover, the code signal comprises information concerning the condition of the beacon transmitter and also concerning its own identification code. When passing along the beacon transmitter 8 the mobile transceiver 3 switches over to the new values which apply to the train control area B, which occurs pursuant to the received code signal.

As already remarked in the preamble of the description the reason why the beacon transmitter 8 transmits not only the parameters (frequency or frequencies, and addressing code) of the control area B, but also those of the control area A is that trains running in the opposite direction also make use of the same beacon transmitter and the same code signal. Thus the mobile transceiver of such a train switches over to the parameters applicable to the control area A pursuant to the information in

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the same code signal.

When passing along the beacon transmitter 8 the mobile transceiver 3a will also detect the identification code of that beacon transmitter. This information is not only offered to the train staff, but also retransmitted by the transceiver 3, due to which this information is also passed on via the fixed transceiver 6 (respectively 4) to the control centre 7 and offered there. An identification code attributed to the mobile transceiver 3 itself and known in the control centre 7 (respectively 5) is sent along with said information by the mobile transceiver 3. From the combination of the identification code of the beacon transmitter 8 and the identification code of the mobile transceiver 3 it can be concluded in the control centre 7 (respectively 5) which train passed along which beacon transmitter. The identification code of the mobile transceiver 3 is moreover used by the control centre 7 (respectively 5) as an addressing code for messages from the control centre 7 (respectively 5) to the train 1. If the beacon transmitter signal moreover comprises information that there is a fault in the beacon transmitter, the mobile transceiver 3 will transmit this information, together with the identification code of the beacon transmitter 8 to the fixed transceivers 6 (respectively 4) which, in their turn, pass it on to the control centre 7 (respectively 5). Owing to said identification code it is known which beacon transmitter 8 is faulty.

Figure 2 shows a more detailed representation of the above-mentioned mobile transceiver 3, consisting of a communication receiver 10, a communication transmitter 11 and a beacon receiver 12; all three of them are connected to one common aerial. The frequencies of the receiver 10 and of the transmitter 11 are controlled from a control unit 13; also the addressing code, which has to be transmitted by the transmitter 11 to get access to the proper control centre 5 or 7 (in figure 1), is obtained from the

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control unit 13. When passing along a beacon transmitter 8 (in figure 1) the parameters stored in the control unit 13 will be exchanged for the parameters applicable to the train control area B (in figure 1). The transceiver 3 is further controlled via the control device 14, to which also a telemicrophone 15 is connected. It is remarked that if the frequency of the beacon transmitter is within the frequency range of the communication receiver 10, the latter can take over the task of the beacon receiver 12 by means of scanning the possible frequencies of the beacon transmitter 8 and of the fixed transceivers 4 respectively 6.

Figure 3 shows a diagram of a beacon transmitter 8 (in figure 1), consisting of two co-operating identical transmitters 20 and 21, each transmitting a signal via a common aerial, which signal is encoded with the parameters described above by the identical encoders 22 respectively 23. The two encoders 22 and 23 have been programmed by means of a control unit 24. Moreover, the control unit 24 monitors the functioning of the transmitters 20 and 21. In case one of the transmitters 20 or 21 does not function or insufficiently functions, the control unit 13 will program into the encoder 23 respectively 22 of the transmitter 21 respectively 20, which functions well at that moment, an alarm code, which is received, together with the identification code of the beacon transmitter, by the mobile transceiver 3 of a passing train 1, and then relayed to one of the control centres 5 or 7.

Finally it is remarked that the present invention applies not only to means of transport such as trains moving entirely over an accurately predetermined road, but also to other means of transport, such as for example motor-cars and buses. The only condition is that the means of transport have to pass along a beacon transmitter at a sufficiently short distance to be able to receive the necessary system signals, going from one control area to another.

F. Claims

1. Radio communication system for establishing and maintaining radio speech or data communications between on the one hand a mobile transceiver disposed in a means of transport which follows an, at least partly, predetermined road, and on the other hand fixed transceivers, located along road sections forming the predetermined road, which fixed transceivers are in communication with a control centre belonging to a road section, which mobile transceiver comprises receiving means and processing means for receiving respectively processing system signals, a fixed beacon transmitter being disposed near a point where a first road section ends and a next one begins, which beacon transmitter transmits a system control signal, and the processing means setting the mobile transceiver on reception of the system control signal received via the receiving means during the time when the beacon transmitter was passed along, characterized in that the system control signal transmitted by the beacon transmitter (8) comprises parameters in an encoded form for the sake of the establishment and maintenance of communications between the mobile transceiver (3) and the fixed transceivers (6) and their associated control centre (7) within the next road section (B), and in that said processing means (13) set the mobile transceiver (3) in conformity with the received parameters on reception of the system control signal.
2. Radio communication system in accordance with claim 1, characterized in that the system control signal transmitted by the beacon transmitter (8) moreover comprises parameters, in an encoded form, for the sake of the establishment and maintenance of communications between the mobile transceiver (3) and the fixed transceivers (4) and their associated control centre (5) within the first road section (A), said processing means (13) comparing the received parameters, on reception of the system control signal, with the parameters set at that moment in the mobile trans-

- ceiver (3), and setting the mobile transceiver (3) in conformity with the parameters deviating from the actually set parameters.
3. Radio communication system in accordance with claim 1 or 2, characterized in that at least part of the parameters relates to the channel frequencies of the fixed transceivers (4 respectively 6) and of the mobile transceiver (3).
4. Radio communication system in accordance with claim 1 or 2, characterized in that at least part of the parameters relates to addressing and/or identification codes to be transmitted along with message signals between the mobile transceiver (3) and the fixed transceivers (4 respectively 6).
5. Radio communication system in accordance with claim 1, characterized in that the system control signal transmitted by the beacon transmitter (8) forms part of a system signal which further comprises complementary data in an encoded form.
6. Radio communication system in accordance with claim 5, characterized in that the complementary system data or at least part of them are conditionally or unconditionally transmitted, either in a modified or in an unmodified form, to the control centre (5 respectively 7) by the processing means (13) via the mobile transceiver (3) and the fixed transceivers (4 respectively 6).
7. Radio communication system in accordance with claim 6, characterized in that the complementary system data comprise an identification code of the beacon transmitter (8).
8. Radio communication system in accordance with claim 7, characterized in that the mobile transceiver (3) transmits the identification code of the beacon transmitter (8) with the addition of an identification code of the means of transport (1).
9. Radio communication system in accordance with claim 6 or 7, characterized in that the complementary system data comprise one or more condition parameters concerning the condition of the beacon transmitter (8) itself.
10. Radio communication system in accordance with claim 9,

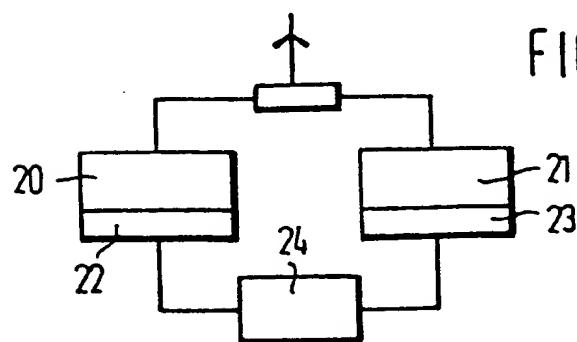
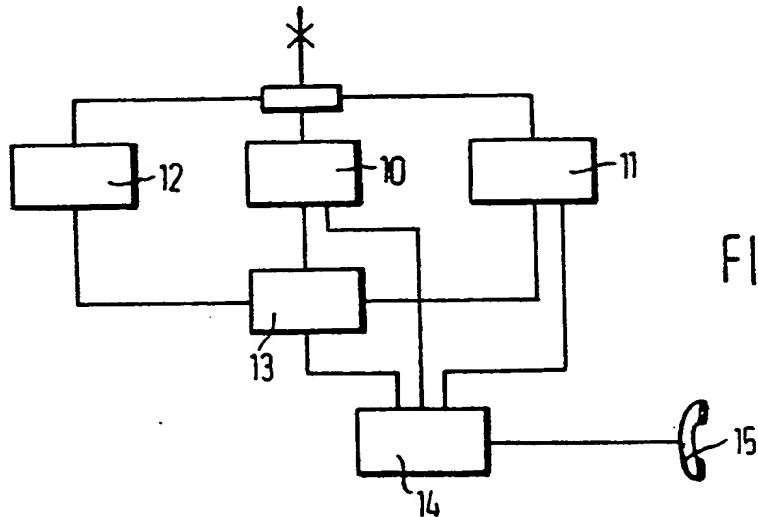
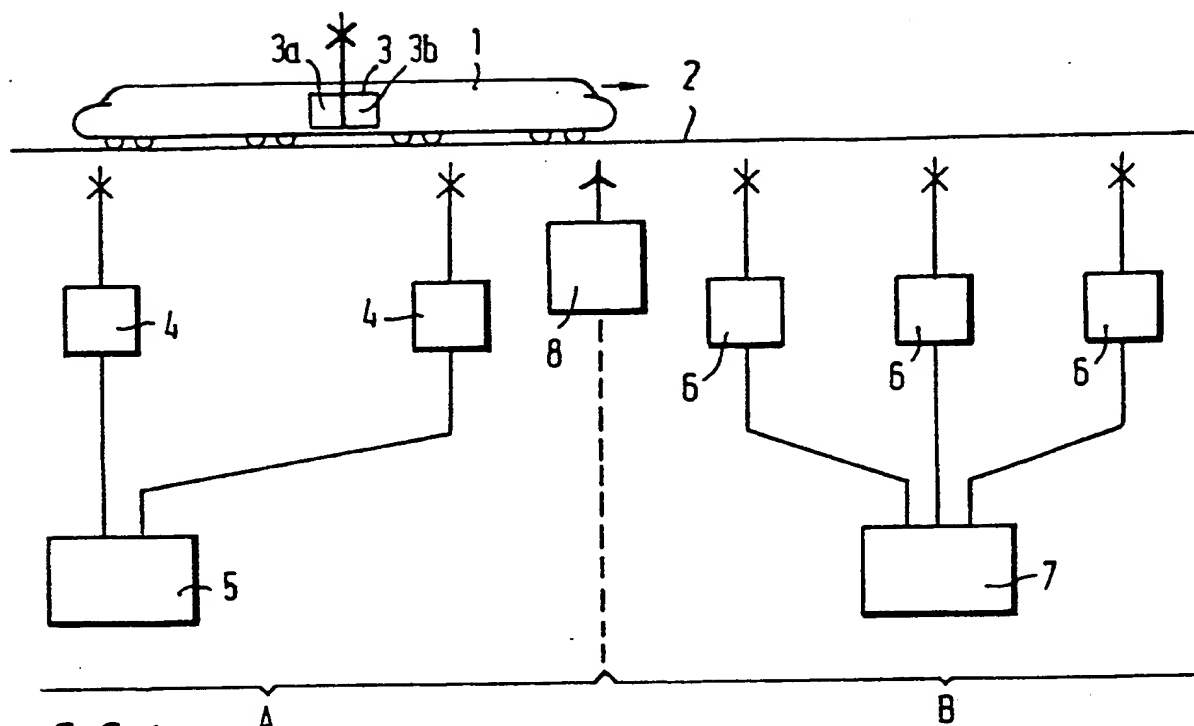
characterized in that the processing means (13) transmit the condition parameters to the control centre (5 respectively 7) dependent on their value.

5 11. Radio communication system in accordance with claim 9, characterized in that the beacon transmitter (8) comprises a first transmitter (20) and a second transmitter (21), the first transmitter transmitting a code signal comprising first condition parameters concerning the condition of the second transmitter, and the second transmitter transmitting a code signal comprising
10 second condition parameters concerning the condition of the first transmitter.

12. Radio communication system in accordance with claim 10, characterized in that the beacon transmitter (8) comprises a first transmitter (20) and a second transmitter (21), which transmit by
15 turns, the mobile transceiver (3) transmitting an alarm signal in the case of an insufficient signal strength of one of the two transmitters, which alarm signal is transmitted to the associated control centre (5, 7) by means of reception by the relevant fixed transceivers (4, 6).

20 13. Radio communication system in accordance with claim 1, the fixed transceivers and the beacon transmitter transmitting at different channel frequencies, and the mobile transceiver comprising scanning and selecting means for scanning receive channels and selecting and switching through the channel with the
25 greatest signal strength, characterized in that said scanning and selecting means scan the channels used by the transmitters of the fixed transceivers (4 respectively 6) within the relevant road section (A respectively B) as well as the channels to be used by the beacon transmitter (8), said scanning and selecting means
30 transmitting the beacon transmitter signal to the processing means (13) of the mobile transceiver (3) after selection of a beacon transmitter channel.

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European Patent
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EUROPEAN SEARCH REPORT

0240051

Application number

EP 87 20 0420

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	NL-A-8 005 861 (PHILIPS' GLOEILAMPENFABRIEKEN) * Claim 8 *	1-4	B 61 L 3/12 H 04 B 7/26 G 08 G 1/12
A	DE-A-2 222 110 (BRITISH RAILWAYS BOARD) * Whole document *	1-4	
A	DE-A-2 143 474 (LICENTIA) * Whole document *	1	
A	FR-A-2 207 279 (RTC LA RADIO TECHNIQUE - COMPELEC) * Claims *	1	
A	GB-A-1 355 803 (STANDARD TELEPHONES AND CABLES) * Claims *	1-4	TECHNICAL FIELDS SEARCHED (Int. Cl.4)
D,A	DE-A-2 644 206 (SIEMENS) * Claims *	1	B 61 L H 04 B G 08 G
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 30-06-1987	Examiner REEKMANS M.V.
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	